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THE INFLUENCE OF A SPECIALLY PROGRAMMED FUNCTIONAL TRAINING IN IMPROVING THE VERTICAL JUMP OF SENIOR SOCCER PLAYERS

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(Original scientific paper)

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Abstract

A survey was conducted on a sample of 50 soccer players between 17 and 30 years of age, with the main goal to determine the quantitative transformational changes of the tests for vertical jump assessment, under the influence of a specially programmed functional training with top soccer players who play at different positions in the team. In order to accomplish the research objectives, three tests for vertical jump assessment were applied: squat jump (SJ), countermovement jump (CMJ), and countermovement jump with arm swing (CMJA). The experimental program was applied within a period of six working weeks with four trainings per week. The trainings were applied with a circular method of work, and the respondents were divided into groups, each of two players. The results of the study suggest that the six-week experimental training program of functional training positively affected the improvement of the average results in the three tests. On the basis of the numerical values of the arithmetic means and the percentage differences, one can conclude that during the period of six weeks, in the entire sample of respondents there was an improvement of 18.20% in the Squat Jump test, the improvement in the Countermovement Jump test was 8.99%, and in the Countermovement Jump With Arm Swing test an improvement of 18.59% was achieved.

Keywords: *jumping, explosive power, measurement*

Introduction

Modern soccer requires players to demonstrate a high level of functional abilities, technical-tactical efficiency, in a word, a morphofunctional universality so that they could act in different situations of the game, often in circumstances such as lack of time, limited space and active interference by the opponent. Hence, only a good level of motor and functional abilities provides an appropriate physical condition of soccer players who effectively act in conditions of high psychophysical load during the entire period of 90 minutes of the match. Lately the functional training adapted for a specific sport is becoming increasingly popular for such preparation of soccer players. Functional training is the opposite of a classical training with devices in the gym. There are no devices in a real functional training. The props that are being used for the training include Russian kettlebells, medical balls, gymnastics hoops, ropes, elastic straps, tires, etc. Functional training also encompasses a great range of exercises that are performed only with the weight of one's own body. Functional training programmed for soccer players is considered to be the most complete way of training, because they work on all important motor characteristics: power, fitness, explosiveness, speed, and endurance. It can be said that the most useful was taken from all sports and it is completed in a very diverse concept. In all exercises, the idea is to include as many muscle groups as possible at the same time. Functional training is a powerful weapon that, with a good combination of exercises, activates all muscles in the body. Specifically, because of the combination of exercises that activates all muscles in the body, including minimum rests, this way of training is very exhausting, physically and mentally. The entire training can last from 30 to 60 minutes, and this is more than sufficient time to spend the power reserves because this method exhausts all three energy compositions (2 anaerobic and 1 aerobic).

Within the concept of a soccer game, the specially programmed functional training contains the key situational activities during the match which include anaerobic type of work, with a large number of sprints, aggressive and powerful duels of explosive character.

The general goal of the research is to determine the quantitative transformational changes of the tests for vertical jump assessment, under the influence of a specially programmed functional trainingin top players who playin different positions in the team.

Materials and Methods

Subjects

The research was carried out on a sample of 50 soccer players between 17 and 30 years of age, who play in the Football Club "Sileks" from Kratovo. The sample was also classified according to the positions of the soccer players: goalkeepers (n = 5), defenders (n = 15), midfielders (n = 15) and strikers (n = 15). Before the start of the measurement in accordance with the Helsinki Declaration, the respondents were informed about the research objectives and the possible risks of injuries. The participation in the research was interrupted if some of the respondents reported certain health problems.

Vertical Jump Tests

After warm-up routine consisted of low-intensity aerobic exercises (3 minutes), dynamic stretching (5 minutes), and single and rebound jumps (2 minutes) was completed. Then, participants performed three protocols of vertical jump tests with proven reliability and validity (19): squat jump (SJ), countermovement jump (CMJ), and counter-movement jump with arm swing (CMJA). Based on a pilot study performed previously, two attempts were carried out for each type of test, allowing 1 minute of rest between attempts of the same test and 2 minutes between different vertical jump tests to ensure total recovery.

The SJ is composed of a concentric phase preceded by an isometric phase with 90º knee flexion. To prevent the use of elastic energy, participants stayed in the isometric phase for 3 seconds. Also, they kept their hands on their hips to avoid arm swing impulse when they were required to perform a maximal jump (15). No sinking or countermovement was allowed.

The CMJ is composed of an initial negative or eccentric phase that finishes with the subject in the squat position with 90º knee flexion and is followed by an immediate concentric or positive phase to perform a maximal jump. Participants kept their hands on their hips.

Finally, the CMJA consists of a CMJ in which arm swing is permitted. All participants performed the swing by beginning with their arms extended in the anatomical position. Any other arm swing was not permitted.

All trials were video recorded to ensure proper technique. Vertical jump performances were collected by an infrared photocell system called Optojump (Microgate SRL, Bolzano, Italy) which was connected to a portable computer with the adequate software (Optojump software, version 3.01.0001) (Glatthorn et al. 2011).

Experimental Training Program of Functional Trainingfor Soccer Players

The experimental program was applied within a period of six working weeks, with four trainingsper week. The trainings were applied with a circular method of work, and the respondents were placed in stations, divided into groups, each of two players.

During the first two weeks, three rounds were performed at each station, with a duration of 20 seconds per station, and a break between the stations of 90 seconds. The following exercises were carried out at the stations: single leg balance on a balance panel, and than with the other leg – soccer ballstrike with the inner side of the foot passed by a teammate with a hand at a distance of 2-3 meters; repetitive lifting with arms of TRX straps from a semi-supine position (back); ropejumps; alternating stepping with the left and the right leg foreward, under the load of an elastic strap, placed around the hips with a length of 3 meters; repetitive lifting with arms of TRX straps from a semi-supineinclined position (biceps); TRX hamstring curls; overturning a tractor tire with a weight of 70 kg from a kneeling position (quadriceps); push-ups with elevated legs while holding a big exercise ball; navy rope - movement of the rope alternately with both hands upwards, downwards and in the shape of an eighth; box jumps with a height of 30-60 cm.

During the third and the fourth week, three rounds were made at each station, with a duration of 30 seconds, and a break between the stations of 90 seconds. The following exercises were carried out at the stations: lifting a Russian kettlebell of 10kg, from a standing position with two hands in front of the head; skip in place under the pressure of an elastic rope with a length of 5 meters; lifting a Russian kettlebell of 8 kg, from a base above the head with one hand; repetition of a push-up and then a high jump under load with an elastic strap; striking a medicine ball of 10 kg with two hands from the base; bands on a hanging

bar; lifting the legs attached to a TRX strip from the position of a push-up towards the chest; kicking a tractor tire with a 12 kg hammer; towing in a sprint of a sledge with a weight of 40 kg at a distance of 30 meters; alternative stepping forward with the right and the left leg and twist to the left and right with a medicine ball of 10kg in a hand.

During the fifth and the sixth week, three rounds were performed at each station, with a duration of 40 seconds per station, and a break of 90 seconds between the stations. The following exercises were carried out at the stations: kneeling with a kettlebell of 10kg; bench jump with a height of 80 cm and with a vest of 20kg, twist with a medicine ball of 10 kg in a sitting position with half-twisted legs; push-up hold with the legs leaned on an exercise ball, alternate pulling of the knees towards the chest and backwards; sprint at a 5 meters run by touching a cone in different directions under the load of a 5-meter long elastic strap; jumps with two legs over obstacles with a height of 80 cm; wall bars folds; side strike from a wall of a10 kg medicine ball; pulling an elastic rope backwards with an alternate stepping with the left and the right leg; push-up hold of an exercise ball, knee to chest stretch, inward twist and rotation of the hips and side leg stretch.

Statistical Analyses

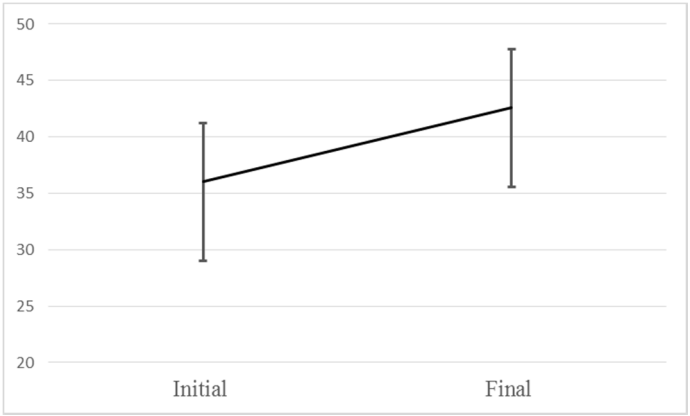
After a test for the normality of distribution, data were expressed as the mean ±SD. The univariate differences in the analyzed variables, between the initial and the final measurement were tested with T-tests for small dependent samples. A probability level of 0.05 or less was taken to indicate statistical significance. All data were analyzed using the Statistical Package for the Social Sciences (SPSS) (SPSS Inc., Chicago, IL, USA, version 22.0).

Results

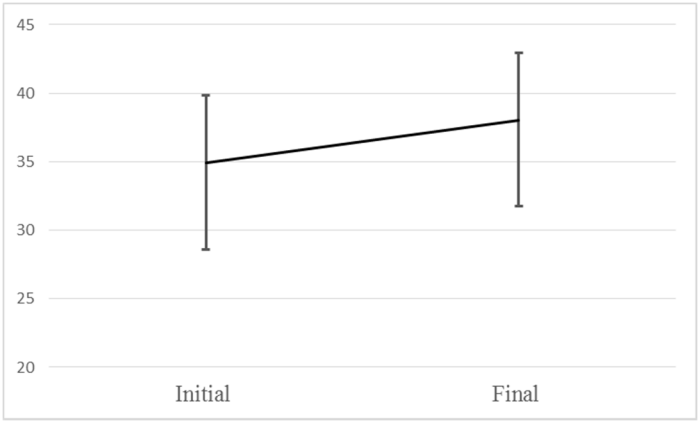
In order to determine the changes in the motor tests for vertical jump assessment, after the conducted six-week training treatment, a univariate testing level (T-test for dependent samples) was applied. The results of the T-test for the investigated groups of respondents are presented in Table 1 and the Graphs 1-3.

Table 1. Differences between the initial and the final measurement of the motor variables in the overall sample of respondents

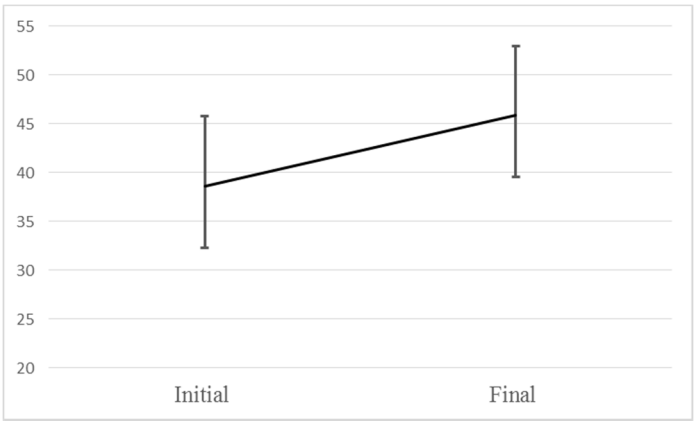
	Initial		Final		r	%	t	df	Sig
	Mean	SD	Mean	SD					
SJ	36,05	5,20	42,60	7,00	0,80	18,20	-8,87	31,00	**0,000**
CMJ	34,91	4,92	38,05	6,31	0,83	8,99	-4,38	23,00	**0,000**
CMJA	38,67	7,10	45,86	6,32	0,28	18,59	-3,76	17,00	**0,002**



Graphs 1. Squat Jump – SJ



Graphs 2. Countermovement Jump – CMJ



Graphs 3. Countermovement Jump with Arm Swing – CMJA

On the basis of the values of the T-tests, the numerical values of the arithmetic means and the percentage differences, it can be concluded that the experimental treatment in the overall sample of the respondents has led to significant effects. The results of the T-tests (Table 1) in all three tests for vertical jump assessment show statistically significant differences between the initial and the final measurement in a positive direction.

Discussion

Despite the endurance nature of soccer, some authors have suggested that different standards of player (Tumilty, 1993) and different playing positions (Brewer and Davis, 1992) are better differentiated by components of speed, power and strength. As far back as 1921 a standing vertical jump test was introduced which was intended to be a measure of general physical performance (Sargent, 1921). More recently considerable research on the standing vertical jump has been undertaken that supports its multifactorial nature, being related to maximum strength and muscular power of the leg extensor muscles (Young et al., 2001). The vertical jump has been assessed with an arm swing and with the arm action restricted to evaluate the contribution of the arms (Harman et al., 1990). Two vertical jump tests, the squat jump (SJ) and the countermovement jump (CMJ) have received most attention from researchers because of the possibility to discriminate between concentric muscle action of the leg extensors and the effect of pre-stretch (Markovic et al., 2004). The authors suggest that the CMJ and SJ, measured by means of contact mat and digital timer, are the most reliable and valid field tests for estimation of explosive power of the lower limbs in physically active men.

The tests Squat Jump – SJ, Countermovement Jump – CMJ and Countermovement Jump with Arm Swing – CMJA were applied in this research for assessment of the explosive strength of the legs. The results of the study suggest that the six-week experimental training program of functional training positively influenced on the improvement of the average results in the three tests. On the basis of the numerical values

of the arithmetic means and the percentage differences, it can be concluded that for a period of six weeks, in the entire sample of respondents there was an improvement in the Squat Jump test of 18.20%, in the Countermovement Jump test the improvement was 8.99% and in the Countermovement Jump With Arm Swing test it was 18.59%. In the final measurement the strikers achieved significantly better statistical results in the three motor tests for vertical jump assessment (SJ, CMJ and CMJA) compared to the midfielders and the defenders. Statistically significant differences have not been found between the midfielders and the defenders in the motor tests. From the overview of Table 2 it can be seen that the players of the overall sample of North Macedonian soccer players treated in this research achieve weaker results in the countermovement jump test compared to top-level adult players.

In the study by Sporiš et al. (2009), it was found that strikers have the highest level of explosive abilities compared to all other players in the field. In another study, Lago-Peñas, Lago-Ballesteros and Rey (2011) found that among young players at the age of 15.63 ± 1.82 years, goalkeepers and central defenders achieve the best results in vertical jumps. Boone, Vaeyens, Steyaert, Vanden Bossche and Bourgois (2012) found that of the adult players from six teams in the Belgian Pro League, goalkeepers and central defenders achieve the best results in vertical jumps compared to the group of defenders, midfielders and strikers, which is consistent with the results of the study by Lago-Peñas et al. (2011). Haugen et al. (2013) studied the Norwegian players including the senior and junior national team in the period from 1995-2010 and found that in vertical jumps, the group of midfielders achieved weaker results compared to the other groups divided according to the position in the team, which is in line with the results of this research. Wisløff, Helgerud, and Hoff (1998) found that the players from the top Norwegian leagues had a greater level of explosive abilities in the groups of defenders and strikers compared to midfielders. Mujika, Santisteban, Impellizzeri and Castagna (2009) did not find differences in terms of the height of the vertical jump between senior soccer players and top young players. Wong and Wong (2009) found that Asian young players achieve weaker results in vertical jumps compared to European and African players. When it comes to the requirements imposed by the game, the high level of explosive abilities is an advantage in individual duels in the air, but also in running, which is confirmed in the research by Wisløff et al. (2004), where a significant correlation between sprint at 10 and 30 meters and vertical jumps was found among top international soccer players.

Table 2.Values of the standing high jump in seniors

Study	Playing Population	n	Jump height (cm)	
			SJ	CMJ
Faina et al. (1988)	Amateurs/Italy	17	34.2	36.9
	Professional/Italy	27	40.4	43.5
White et al. (1988)	Division 1/England	17		59.8
Dowson et al. (1999)	National/New Zealand	25		48.1
Cometti et al. (2001)	Division 1/France	29	38.5	41.6
	Division 2/France	34	33.9	39.7
	Amateur/France	32	39.8	43.9
Jaric et al. (2001)	Division 1/Yugoslavia	20		49.5
Hoff and Helgerud (2002)	Division 2/Norway	8	38.6	44.1
Aziz et al. (2004)	S-League/Singapore	147		58.4
Hoshikawa et al. (2007)	Professional/Japan	30	42.8	57.1
Mujika et al. (2009)	Division 1/Spain	17		50.1

Conclusions

On the basis of the obtained results, one can come to a conclusion that the six-week experimental training programs of functional training positively affected the improvement of the average results in the three tests. On the basis of the numerical values of the arithmetic means and the percentage differences, it can be concluded that for a period of six weeks, there has been an improvement in the entire sample of respondents, as follows: 18.20% improvement in the Squat Jump test, 8.99% in the Counter Movement Jump test, and 18.59% in the Countermovement Jump with Arm Swing test.

The results of the research are a valuable material for scholars, but also for trainers, experts, and football analysts. Considering that football is one of the most popular sports in the world, tests for assessing the physical and motor performances should be applied when selecting talented players, along with

anthropometric and somatotypic research, and simultaneously the growth and development of players should be monitored.

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